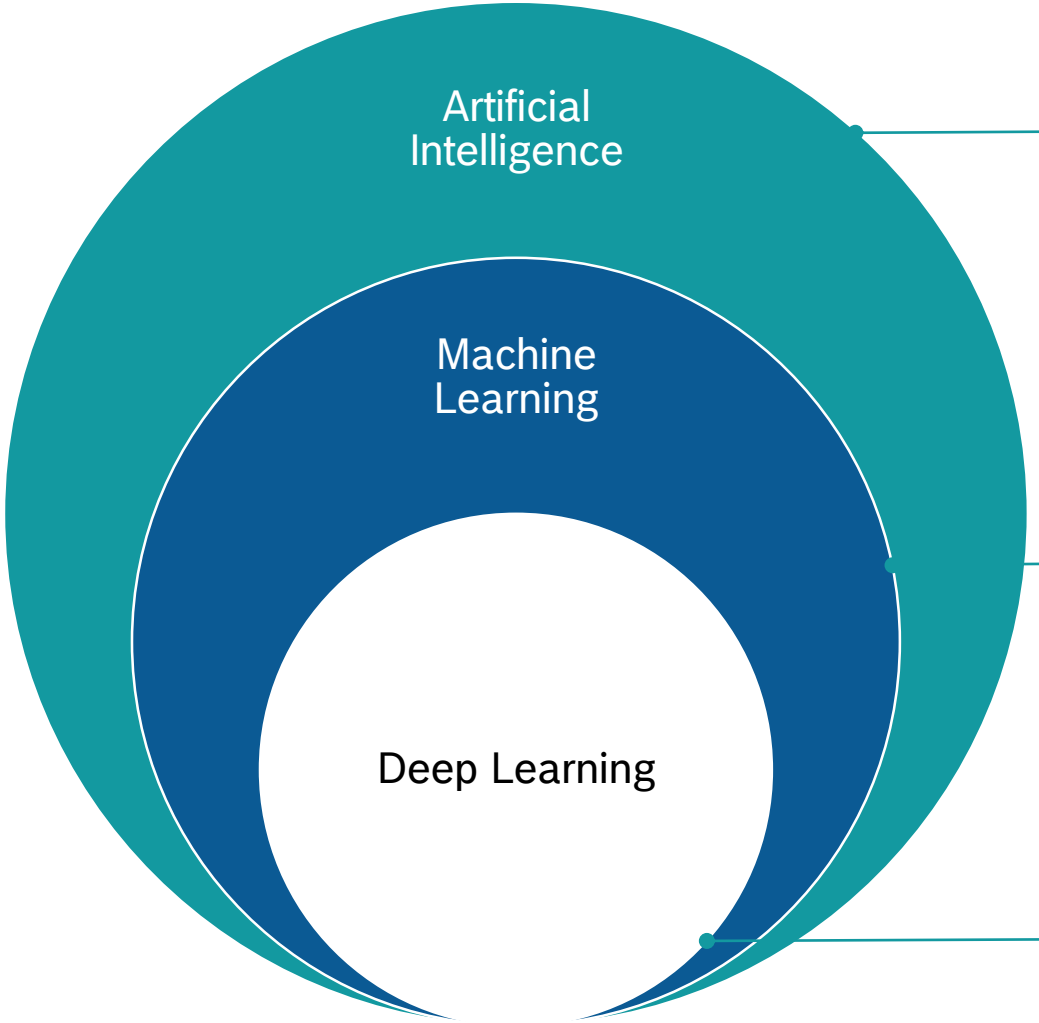
ROBERT BOSCH ENGINEERING AND BUSINESS SOLUTIONS

ARTIFICIAL INTELLIGENCE

BOSCH

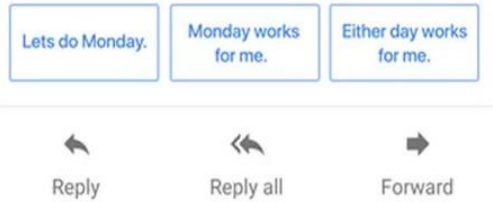
What is Artificial Intelligence(AI)?



Artificial Intelligence

Ability of machines to perform functions similar to that of human mind

Ex: ML



Machine Learning

Ability of computer systems to improve their performance without need to follow explicitly programmed instructions

Ex: DL

Deep Learning

Sets up basic parameters about the data and trains the computer to learn on its own by recognizing patterns using multiple layers of processing

BOSCH

Artificial Intelligence @ Bosch
AI Topics

Data-driven Physical Modeling

CAPABILITIES
Data-based, non-parametric, dynamic, and real-time-capable regression models from system measurements.

DEPLOYMENT
Prediction models used for system optimization, diagnosis and controller design.

Explainable Deep Learning

CAPABILITIES
Apply DL algorithms with a guaranteed reliability to meet functional safety requirements.

DEPLOYMENT
Sensor data and environmental uncertainty can be quantified explicitly.

Large Scale Deep Learning & AI

CAPABILITIES

Novel DL algorithms for video understanding
Large scale machine learning and AI

DEPLOYMENT
Basis for scaling up AI; video search DL models

Robust Control Learning

CAPABILITIES
Automatically calibrate and adapt controllers, ensuring performance and stability.

DEPLOYMENT
Basis for products that learn and adapt.

Environment Understanding & Decision Making

CAPABILITIES
Understand scene, object context and relationships beyond classification and act accordingly.

DEPLOYMENT
Intelligent decision making in multiple domains.

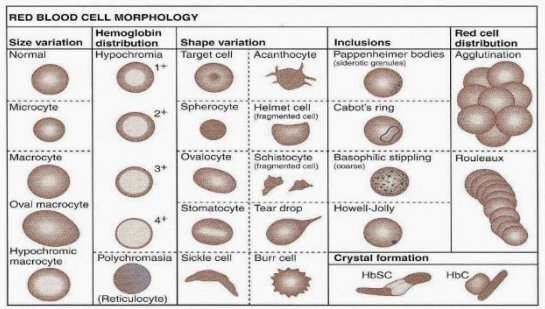
Dynamic Multi-Agent Planning

CAPABILITIES
Optimal and safe robotic behavior in an uncertain environment, where requests vary dynamically.

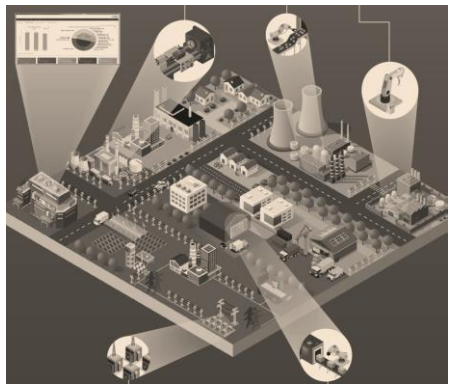
DEPLOYMENT
Real time planning process.

Artificial Intelligence @ Bosch

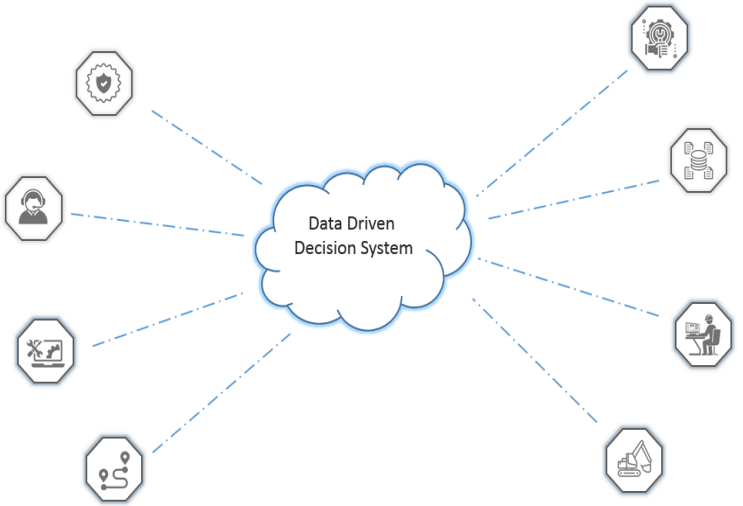
Intelligence Across Domains

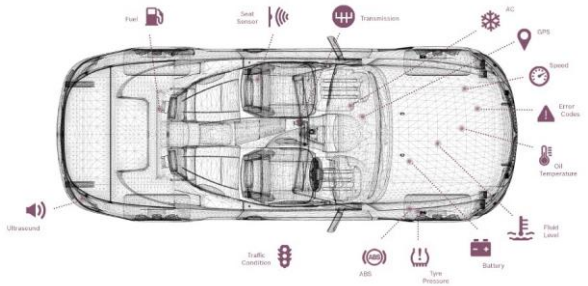


HEALTHCARE

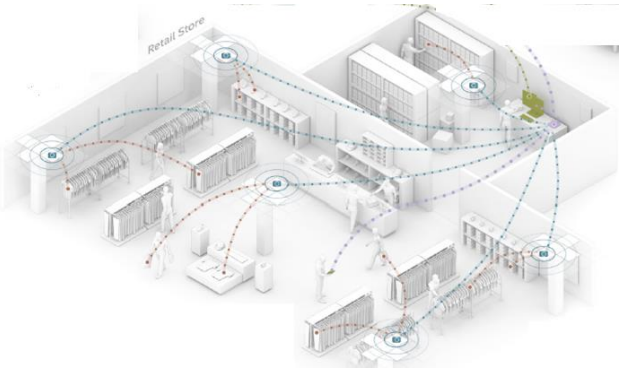


CONNECTED ASSETS AND ENERGY





CONNECTED VEHICLES

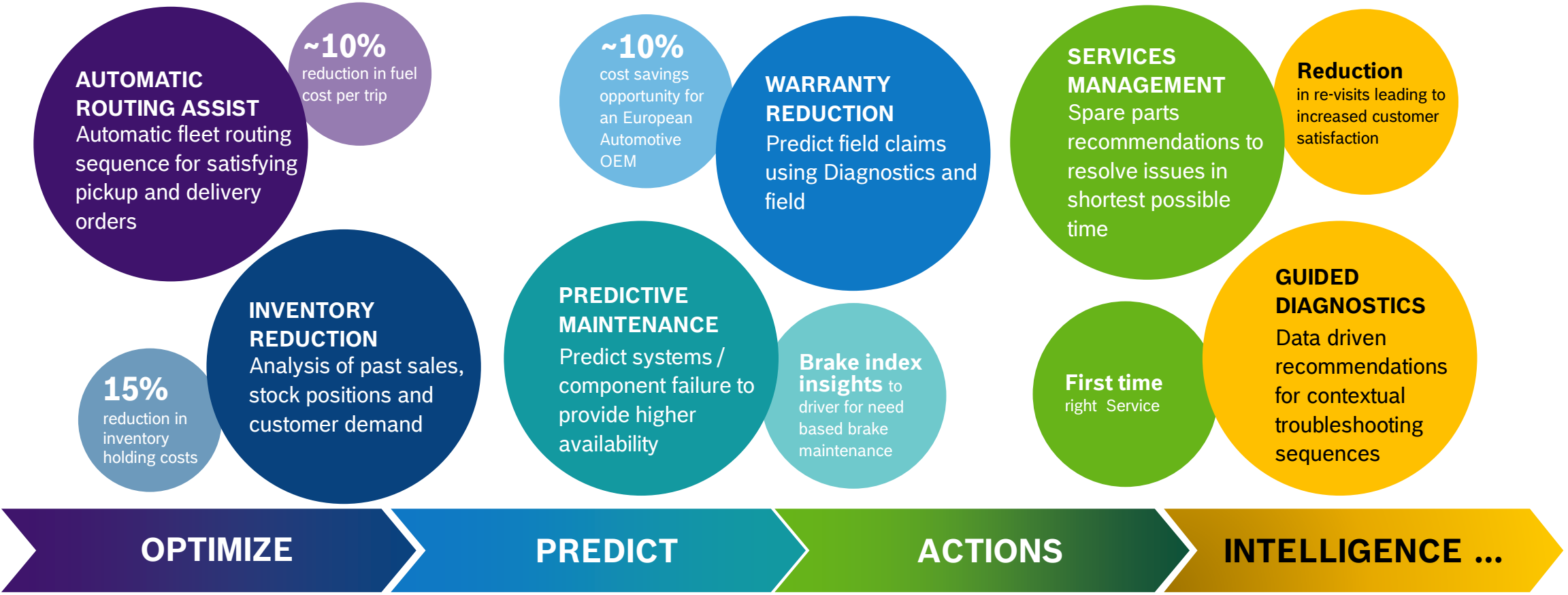


RETAIL

AGRICULTURE

BOSCH

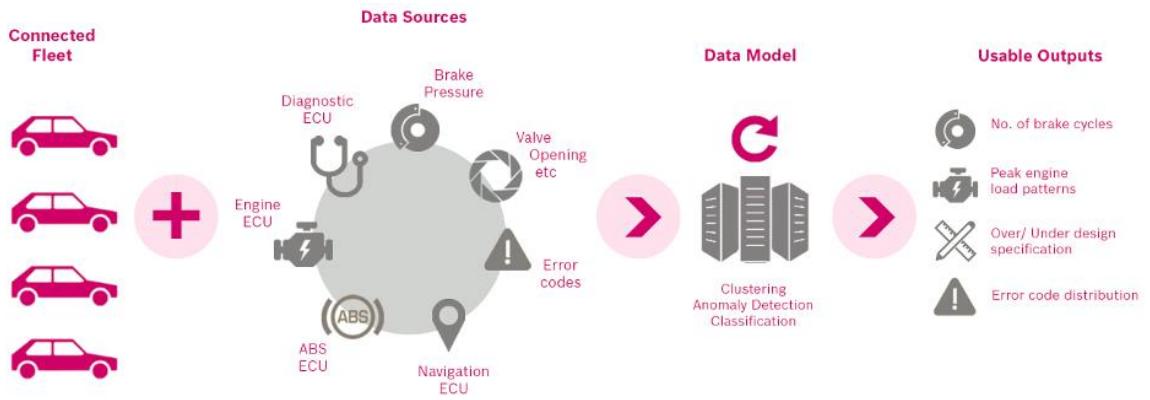
Artificial Intelligence and Digital Analytics
Business Benefits Realized



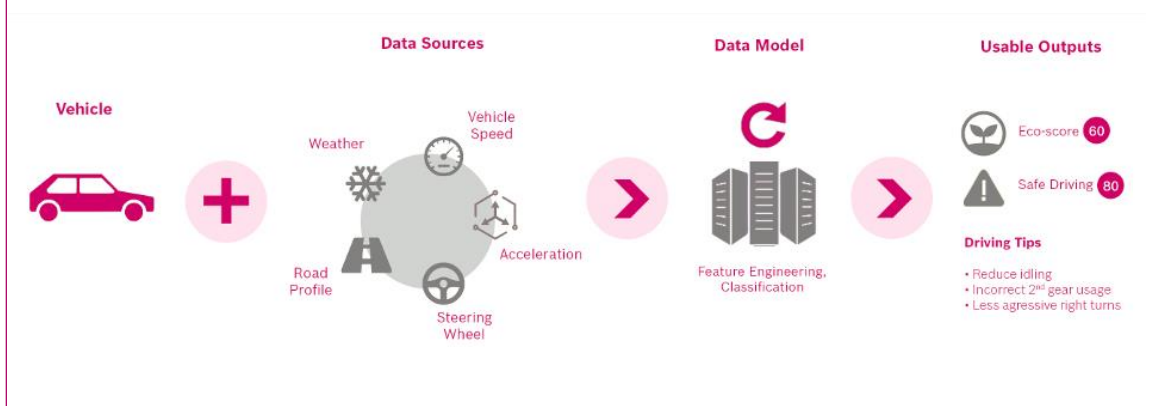
BOSCH

Artificial Intelligence for Connected Vehicles

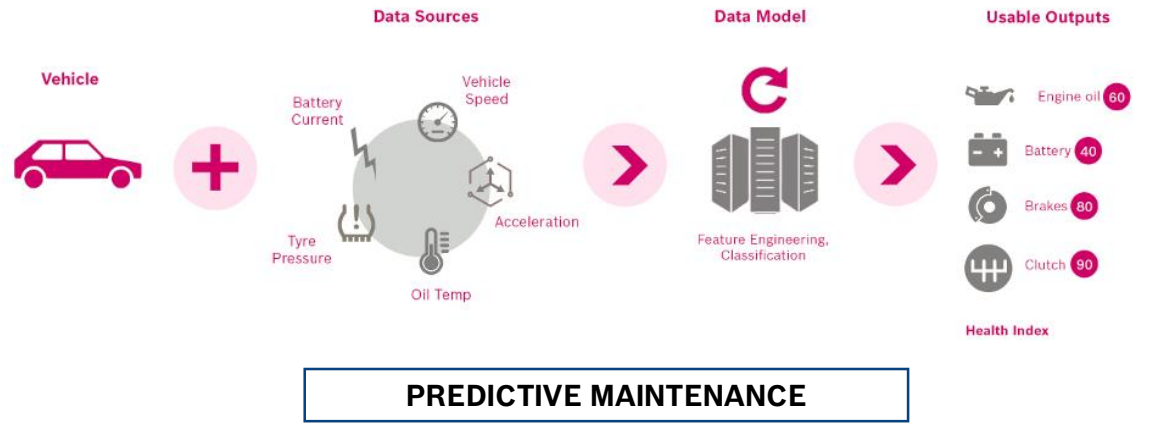
Connected Vehicle Analytics



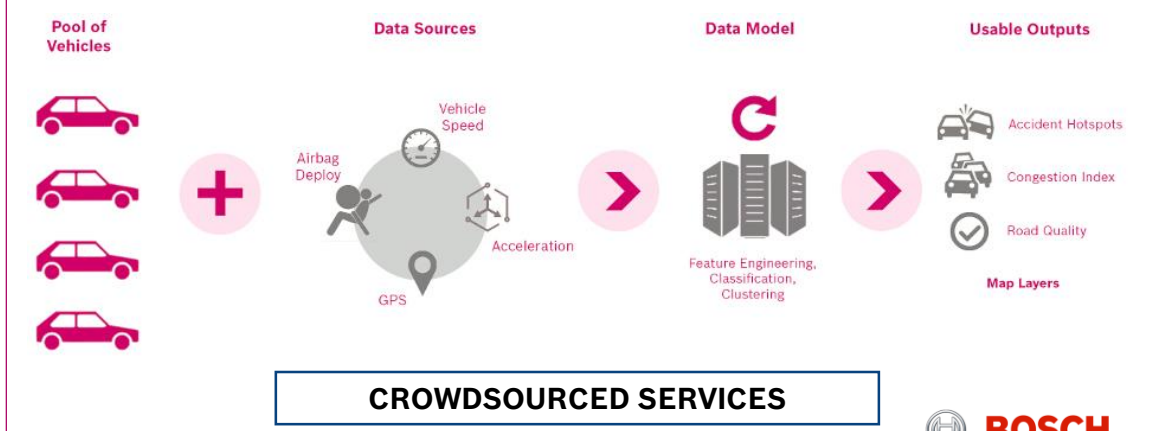
VEHICLE ENGINEERING



DRIVING ANALYTICS



PREDICTIVE MAINTENANCE



CROWDSOURCED SERVICES

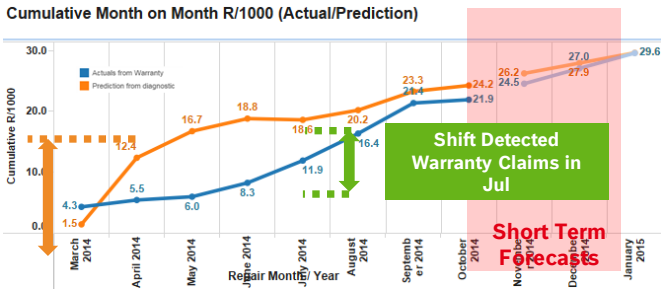
BOSCH

Artificial Intelligence for Field Data Analysis
Early Warning System for Warranty Claims

Business Objective

Early warning system to predict field claims for transmission of OEM

Data Sources & Analytics Approach

DATA	METHODOLOGY	RESULTS
Field Diagnostics Data ▶ 43k global VIN sessions ▶ Diagnostics trouble codes ▶ Data identifier ▶ Module, Fault type + **Other Data Sources** ▶ Vehicle Diagnostic data ▶ Hotline support ▶ Warranty claims ▶ Manufacturing data ▶ Technician's comments ▶ Roadside Assist	▶ Algorithmic ETL ▶ Association Mining ▶ Graph clustering ▶ Page ranking ▶ Similarity measures	 DTC = diagnostics trouble code VIN = vehicle Identification number DID = data Identifier

Result

- Development of early warning system to detect quality issues using vehicle diagnostic information
- Identification of VINs with risk of failure

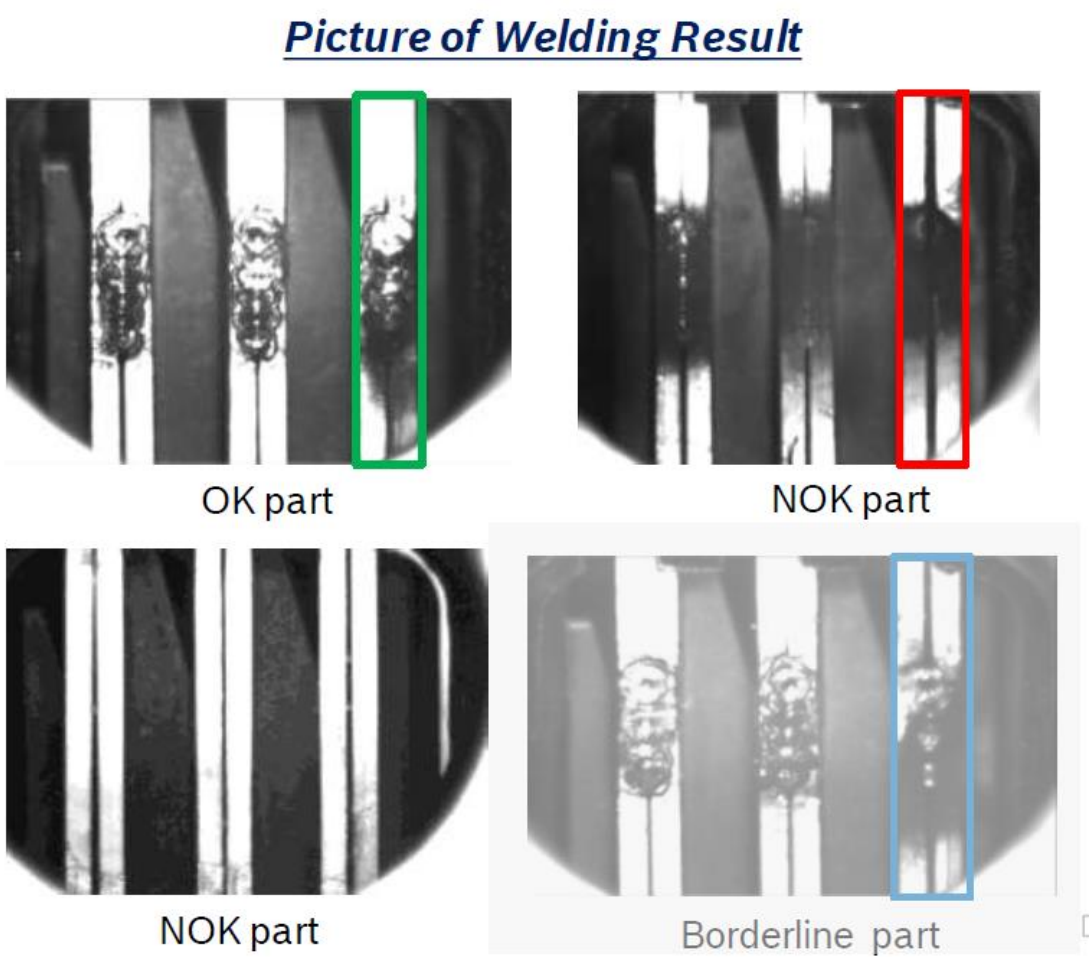
Value

7% reduction in annual warranty costs and prediction of field failures at least 2 months prior to occurrence

BOSCH

Artificial Intelligence for Manufacturing Quality Control

Image Analytics for End of Line Quality Inspection



Scope

Identify welding failures at end of line for pin pair gap (using **deep learning** based approaches)

Results

- *Overall objective attained*: Detect NOK parts with 100% accuracy
- *Phase 1*: 15% OK parts classified as NOK parts
- *Phase 2*: 1% OK parts classified as NOK parts

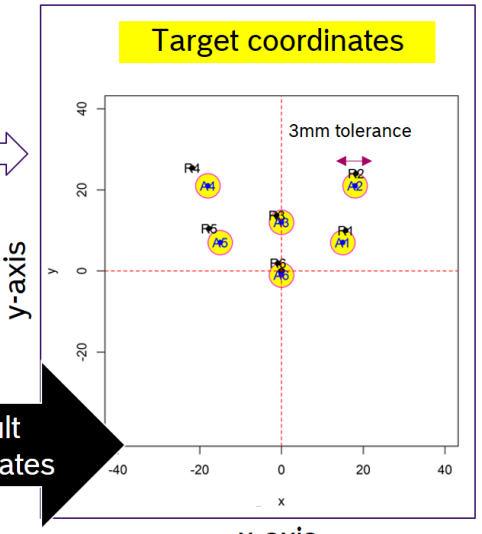
BOSCH

Artificial Intelligence in Engineering
Precision Design of Injector Pumps

Error rate reduced by 26% and increase in cycle time

- For each injector, the target coordinates of spray plume are defined 30mm away from the spray hole as in the figure
- Spray plume should hit the target within 3mm tolerance
- If any spray plume fails, Injector is faulty and discarded.

Result coordinates



Artificial Intelligence in Agriculture

Drone-based image analytics: blueberry counting

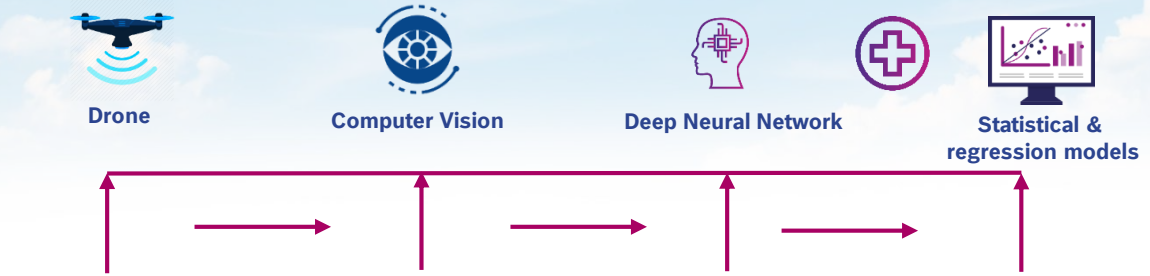
Smart image analytics solution to better estimate harvest dates and volume

Situation

1800 hectares farm employs close to **12000 workers** to manually harvest the berries

Use technology to better estimate harvest **dates** and **volume** of the harvest

Life cycle of a blueberry goes through **7 different stages** and lasts **87 days**



Benefits

Complete visibility of the health of the crop

Production Volume Estimation

Precision Farming

Competitive farming

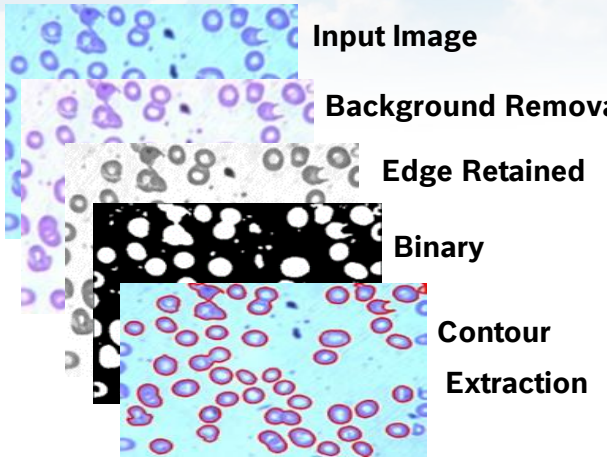
Scalable smart platform and sensor infrastructure for remote farm monitoring

BOSCH

Artificial Intelligence in Medical Sciences

Intelligent image processing, ML based classification

Advanced Image Processing



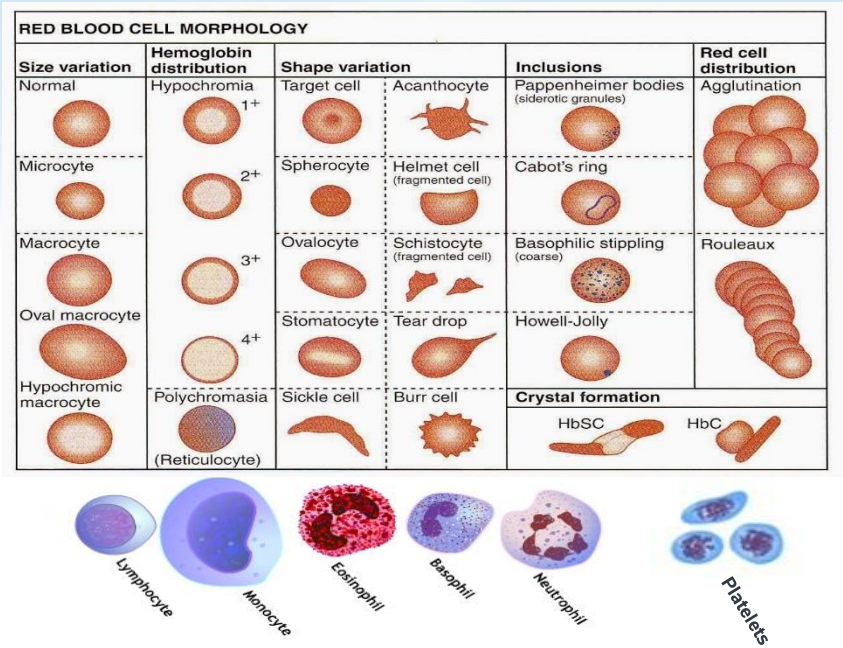
Input Image

Background Removal

Edge Retained

Binary

Contour Extraction



Key Benefits

- Manage scale of users
- Reduce the demand for experts
- Reduce manual errors
- Improved turn around time
- Enable digital healthcare

How AI solves this problem?

Analysis of millions of cells are performed at sub-cellular level based on

Size analysis,
Morphological analysis,
Colour analysis,
Textural analysis,
Count analysis

where AI plays a vital role by providing standardized and reproducibility of results

Machine Learning and AI methods help in analysing millions of cell at submicron level

THANK YOU

BOSCH